

**Chapter 12 Forces and Motion****Section 12.4 Universal Forces****(pages 378–382)**

*This section defines four forces that exist throughout the universe. Each force is described and its significance is discussed.*

**Reading Strategy (page 378)**

**Comparing and Contrasting** As you read this section, compare two universal forces by completing the table. For more information on this Reading Strategy, see the **Reading and Study Skills** in the **Skills and Reference Handbook** at the end of your textbook.

Universal Nuclear Forces			
Force	Acts on Which Particles?	Acts Over What Distance?	Relative Strength
Strong nuclear			
Weak nuclear			

1. What are the four universal forces?

- a. \_\_\_\_\_ b. \_\_\_\_\_  
c. \_\_\_\_\_ d. \_\_\_\_\_

**Electromagnetic Forces (pages 378–379)**

2. Is the following sentence true or false? Electromagnetic force is associated with charged particles. \_\_\_\_\_
3. Name the only two forces that can both attract and repel. \_\_\_\_\_  
\_\_\_\_\_
4. Objects with like charges \_\_\_\_\_ one another, and objects with opposite charges \_\_\_\_\_ one another.
5. Circle the letters of the sentences that correctly describe magnets or magnetic forces.
- a. Magnetic forces act on certain metals.
  - b. Magnets have two poles, north and south.
  - c. Two poles that are alike attract each other.
  - d. Magnetic forces can both attract and repel.

**Nuclear Forces (pages 379–380)**

6. The force that holds particles in the nucleus together is the \_\_\_\_\_.
7. What evidence suggests that nuclear forces have a powerful force of attraction? \_\_\_\_\_  
\_\_\_\_\_

## Chapter 12 Forces and Motion

8. Circle the letter of the best answer. Over extremely short distances, approximately how many times stronger is the strong nuclear force than the electric force of repulsion?
  - a. 10
  - b. 100
  - c. 1000
  - d. 10,000
9. Compare and contrast the strong and weak nuclear forces. \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

### Gravitational Force (pages 380–382)

10. State Newton's law of universal gravitation. \_\_\_\_\_  
 \_\_\_\_\_
11. Circle the letter of each sentence that is true about gravitational force.
  - a. The closer two objects are to one another, the weaker the gravitational force.
  - b. The farther apart two objects are, the weaker the gravitational force.
  - c. The greater the mass of an object, the stronger its gravitational force.
  - d. Earth's gravitational force is stronger than the gravitational force of the sun.
12. The gravitational force of attraction between two objects depends on \_\_\_\_\_ and \_\_\_\_\_.
13. Is the following sentence true or false? Gravity is the weakest universal force, but it is the most effective force over long distances. \_\_\_\_\_
14. The sun's mass is much greater than the mass of Earth, so the sun's gravitational force is much \_\_\_\_\_ than that of Earth.
15. Why does the moon orbit Earth in a nearly circular path? \_\_\_\_\_  
 \_\_\_\_\_
16. Is the following sentence true or false? The gravitational pull of the moon is the primary cause of Earth's ocean tides.  
 \_\_\_\_\_
17. Is the following sentence true or false? The pull of Earth's gravity can slow an artificial satellite, causing it to lose altitude and fall from the sky. \_\_\_\_\_
18. List four uses of artificial satellites. \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_